A METHOD OF FABRICATING CONTACT STRIPS FOR ELECTRICAL DEVICE CONNECTORS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to French Application No. 03 00982, filed on January 29, 2003, entitled: "Method of Fabricating Contact Strips For Electrical Device Connectors" and was not published in English.

BACKGROUND OF THE INVENTION

Field of the invention

[0002] The invention relates to a method of fabricating contact strips for electrical device connectors by segmenting a secondary strip of contacts fabricated from a metal ribbon in which openings are formed with an original pitch to form a discontinuous central strip of blades whose longitudinal ends are attached to two continuous edge strips of said ribbon and each of said blades is twisted about its longitudinal axis to pivot relative to the plane of said ribbon and bent so that each of its two faces has at least one projecting area to form a contact on one side of said plane, said twisting and bending producing a primary contact strip whose blades are spaced at substantially the same regular pitch as the original pitch of said openings, the method further including pleating said primary contact strip by forming pleats on each continuous edge strip to move said blades closer together, the method also including a hardening heat treatment to impart hardness to said blades combined with some elasticity so that they function as springs.

Description of the prior art

[0003] The ribbon used in a method of the above kind disclosed in the patent document FR2811147 is not necessarily a metal ribbon. In practice, an alloy based on beryllium is often preferred. The central portion of one face of the ribbon is covered with a layer of a metal that is a good electrical conductor, for example silver. One edge of each blade is bent like a welt in the direction such that the conductive layer remains on the outside, so that current can pass between the two contacts of the blade through the conductive layer. The layer must therefore be thick enough to have an appropriate conduction section. The central portion of one face of the ribbon is usually covered with the conductive layer by a mechanical laminating operation, and therefore has less elasticity than the edge portions of the ribbon after heat treatment to harden the contact strip.

[0004] In the above prior art method, the edge portions of the ribbon must not be covered by the conductive layer, so that after heat treatment they retain the elastic properties that enable the blades to function as springs. It may be noted that this necessity exists in other types of contact strips with blades, such as the individually fabricated strips with blades disclosed in the patent document FR2339259. It should be pointed out that if a connection member applies to a blade of a contact strip a pressure perpendicular to the plane of the strip, the blade must be able to pivot relative to that plane whilst at the same time exerting an elastic return force against the connection member to provide a reliable contact.

[0005] Furthermore, the pleating operation yields contact strips with a large number of blades per unit length of strip. Because the edge portions of the ribbon are not covered, pleating can produce one or more pleats, for example a single narrow pleat bent substantially parallel to the plane of the ribbon, as disclosed in the patent FR2811147 previously

mentioned. There is therefore no particular difficulty in obtaining a high density of blades along the length of a contact strip with this method.

[0006] Although it produces contact strips that are highly satisfactory, in particular in terms of their electrical conduction capability at high currents, especially currents of the order of 1 000 amperes or more, which are often present in medium-voltage and high-voltage installations, the method that is the subject matter of the patent mentioned above has a number of drawbacks. First of all, pleating an edge of each blade like a welt is difficult, in particular because the applied metal layer that covers one face of the edge must be sufficiently thick to provide sufficient electrical conductivity between the two opposite contact areas on each blade, which imposes a penalty in terms of fabrication cost. Secondly, the mechanical lamination operation is relatively costly in itself, especially compared to an electrolytic galvanization operation.

[0007] One conventional method of fabricating contact strips uses electrolytic galvanization of ribbons of contact blades. This operation is carried out virtually at the end of the process, after the blades have been formed in each ribbon, the ribbons have been cut to the required lengths for the contact strips, and each cut ribbon has subsequently undergone heat treatment such as annealing to confer the required elastic properties on the blade. It should be noted that the edge portions of the ribbons are not subjected to any pleating, and that a finished contact strip is formed of two galvanized strips of the same length interleaved one within the other, as shown in the patent document FR2100220. This doubles the number of blades per unit length and achieves the density of blades required for use in high-current applications.

[0008] With the above conventional method, it would not be possible to achieve the same density of blades on a single-ribbon contact strip. Because galvanization takes place after forming the blades, the blades must not be too close together, because the metal layer obtained by electrolytic galvanization then has a thickness that is too irregular, in particular because of phenomena referred to as shadow cones affecting the blades. A shadow cone is defined as a portion of a blade located behind another blade in the direction of the galvanization electric field. Moreover, the more the blades overlap in the direction perpendicular to the ribbon, the greater the risk of air bubbles being trapped during galvanization. As it is difficult to clean the ribbons thoroughly in the galvanization baths to evacuate trapped bubbles, there remains the risk of local interruption of the continuity of the metal layer. The conventional solution of interleaving pairs of ribbons of blades has therefore been adopted to guarantee satisfactory galvanization of each blade.

[0009] However, this solution has the drawback of being relatively costly. Moreover, in this kind of method it is desirable for the ribbons to be cut to the required length before interleaving a pair of galvanized ribbons, because it would be more difficult and costly to cut a pair of ribbons that had already been interleaved. Thus the double-ribbon contact strips obtained must have different lengths, corresponding to the dimensions of the connectors for which they are intended, which means that numerous different items have to be held in stock in order to be able to fill orders rapidly. This solution therefore represents a penalty in terms of storage cost and delivery time.

[0010] The invention aims to eliminate the drawbacks of the above prior art solutions by proposing a solution that in particular enables orders to be filled rapidly but is less costly in terms of fabrication and storage.

SUMMARY OF THE INVENTION

[0011] The invention provides a method of fabricating contact strips for electrical device connectors by segmenting a secondary strip of contacts fabricated from a metal ribbon in which openings are formed with an original pitch to form a discontinuous central strip of blades whose longitudinal ends are attached to two continuous edge strips of said ribbon and each of said blades is twisted about its longitudinal axis to pivot relative to the plane of said ribbon and bent so that each of its two faces has at least one projecting area to form a contact on one side of said plane, said twisting and bending producing a primary contact strip whose blades are spaced at substantially the same regular pitch as the original pitch of said openings, said method further including pleating said primary contact strip by forming pleats on each continuous edge strip to move said blades closer together, and a hardening heat treatment to impart hardness to said blades combined with some elasticity so that they function as springs, and which method begins with the following three steps:

a) said ribbon is metal-plated on both sides to cover at least said central strip with a layer of a metal that is a better electrical conductor than the metal of said ribbon,

b) said openings are formed in said ribbon, and

c) each of said blades is twisted and bent,

and then includes the following successive operations:

d) the two continuous edge strips of said primary strip of contacts are pleated,

e) said hardening heat treatment is applied to the contact strip obtained after the foregoing operations, to produce said secondary contact strip, and

f) said secondary contact strip is segmented into a plurality of contact strips ready to be mounted on the connectors for which they are intended with a strip length as required for

each connector.

[0012] The secondary contact strip can be obtained from a long ribbon and shipped in the form of a spool, for example, which is cut into contact strips by the client just before the strips are assembled into the connectors.

[0013] Said ribbon is advantageously metal-plated by galvanization. The galvanization can be carried out electrolytically using silver, for example. The ribbon to be galvanized can consist of a beryllium-bronze alloy, which has poor electrical conductivity but good resilience after heat treatment. This is known in the art. The heat treatment of the beryllium-bronze can consist of heating it to approximately 320°C for four hours, followed by gradual cooling.

[0014] In a preferred embodiment of the method, all of the surface of said ribbon is covered during the metal-plating operation. With metal-plating by electrolytic galvanization in particular, in the present state of the art it is less costly to galvanize the whole surface rather than to treat only the central strip of the ribbon.

[0015] In an embodiment of the method in which the openings in the ribbon are punched out, i.e. cut out using a punch and a die that fit one within the other, to form relatively wide holes, the operation of metal-plating the ribbon is carried out before said punching.

[0016] In a preferred embodiment of the method, during said pleating operation, said blades are moved closer together so that they are regularly spaced with a new regular pitch such that the ratio between the original pitch and the new pitch is from 1.3 to 2. In the remainder of this description, this ratio is referred to as the blade approach factor. There is a range of values for this ratio in which the new pitch corresponds to a blade density

sufficiently high to guarantee performance in high-current applications at least as good as that of contact strips made by the prior art methods previously referred to.

[0017] Other features and advantages of a fabrication method according to the invention will emerge in more detail in the remainder of the description with reference to the appended drawings.

[0018] Finally, the invention also provides a contact strip for connecting an electrical device, obtained from a metal ribbon in which openings are made to form a discontinuous central strip of blades and the whole of the surface of said contact strip is plated with a layer of a metal that is a good electrical conductor, longitudinal ends of said blades are attached to two continuous edge strips of said ribbon that are bent with transverse bends and said blades are regularly spaced with a regular pitch, which contact strip is characterized in that each pleat has a height such that the ratio between said regular pitch and said height is from 1.7 to 2.5. The dimensional characteristics of each pleat in this kind of contact strip are particularly advantageous in allowing pleating that is relatively simple to carry out and entails no risk of breaking the conductive metal layer in the area of said continuous edge strips of the ribbon.

[0019] A contact strip according to the invention of the above kind is particularly beneficial from the point of view of the performance/cost trade-off if it is obtained by a fabrication method according to the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1, 1a, 2 and 3 show steps of one embodiment of a method according to the invention for fabricating contact strips with a high blade density.

Figure 3a is a diagram showing an alternative embodiment of a transverse pleat in a ribbon of blades.

Figure 4 is a diagram showing an appropriate blade shape for each of the two faces of the blade to have two contact areas.

Figure 5 is a diagram showing in cross section a contact strip formed from a ribbon of blades like that shown in figure 4 installed in part of a connector.

Figure 6 is a diagram showing in cross section a contact strip analogous to that shown in figure 5 installed in a part of a connector that includes means for immobilizing the strip longitudinally.

Figure 6a is a diagram showing the figure 6 device in longitudinal section.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0020] Figure 1 shows a metal ribbon 9 covered on both faces with a layer 15 of a metal that is a good electrical conductor, as can be seen in figure 1a. In the remainder of the description, the expression "good electrical conductor" refers to any metal that is a significantly better conductor than the metal of the ribbon. At least the central strip CS of the ribbon is covered by the layer 15 and regularly spaced openings 12 are punched into the central strip, as can be seen in figure 2. The openings can optionally be made before the ribbon is covered with the layer 15 of metal that is a good conductor, as explained below.

[0021] It is assumed in the remainder of the description that the whole of the surface of the ribbon 9 is covered during the metal-plating operation and that the openings 2 are formed after metal-plating. The metal of the ribbon is an alloy of beryllium and bronze, for example, which is a relatively poor electrical conductor, and the metal-plating process is electrolytic galvanization in a bath of silver, for example. If the whole of the ribbon is galvanized, the edges of the ribbon are covered with a layer joining its two faces, like the layer 15s shown in figure 1a.

[0022] As shown in figure 2, the openings 2 are formed in the metal-plated ribbon from figure 1a with an original regular pitch d_1 in the direction of the longitudinal axis A of symmetry of the ribbon, to form a discontinuous central strip CS of blades 3 whose longitudinal ends 31 and 32 are attached to two continuous edge strips ES_1 and ES_2 of the ribbon. It is preferable for the openings to be relatively narrow at their waists, which in this embodiment are along the longitudinal axis A of symmetry of the ribbon, in particular to obtain as small as possible an original pitch d_1 for a given blade width D, and also to limit the quantity of scrap material.

[0023] The width D of each blade is preferably greater than approximately 80% of the original pitch d_1, which amounts to saying that the width of an opening at its waist is at most equal to approximately 20% of d_1, since this width at the waist is equal to d_1 - D. For a particular blade width D, it is not desirable for the original pitch d_1 of the openings to be much greater than D, as this would impose the use of a longer metal-plated ribbon and increase the width of the openings, which would represent a fabrication cost penalty. Furthermore, with a pleating operation producing pleats protruding from the same side of the ribbon, as described below, the height of the pleats increases with the original pitch d_1, although it is not desirable to have pleats that are too large, which could impede the fitting of the contact strip to the connector for which it is intended.

[0024] The two edge strips ES_1 and ES_2 of the ribbon are externally notched to form tongues 4 that are used to connect the contact strip with a portion of the connector for which it is intended. In this embodiment the blades 3 are symmetrical with respect to their longitudinal axes A_T, which are perpendicular to the longitudinal axis A, but a design could

be envisaged that is not perfectly symmetrical, adopting a slightly asymmetrical shape of opening.

[0025] Conventionally, the blades are then subjected to a twisting operation about their longitudinal axis to pivot them relative to the plane of the ribbon so that the two faces of each blade form respective contacts 3A and 3B protruding on each side of this plane, as can be seen in the first portion of figure 3. This twisting operation is conventionally accompanied by bending the two edges of each blade in at least one longitudinal plane perpendicular to the plane of the ribbon to form on each face of a blade at least one contact area in which the current flows between the blade and a portion of a connector. In the remainder of the description, it is to be understood that a contact 3A or 3B comprises at least one contact area.

[0026] In a fabrication method according to the invention, it is generally preferable, for cost reasons, for the operations of cutting out the blades and the tongues, twisting and bending the blades, and pleating the continuous edge strips of the ribbon to be carried out during a continuous process performed in a single installation. This is because it is less costly, in particular in terms of labor costs, not to have to reinstall or adjust the ribbon between operations. This is why it is generally preferable for the metal-plating operation to be carried out right at the beginning of the fabrication method according to the invention.

[0027] Furthermore, it must be noted that when punching a solid metal-plated ribbon, as shown in figure 1a, electrical conduction between the two layers that cover the two faces of the blades of the ribbon is effected only through the thickness of the metal of the ribbon. This is because a blade cut by a punch does not have on its edges a metal layer joining its two surface layers, such as the layer 15s that can be seen on the edge of the ribbon in figure

1a. The metal of a contact strip ribbon is usually not a good electrical conductor. However, as this kind of ribbon is usually relatively thin, typically from 0.10 mm to 0.40 mm thick, high currents can be conducted provided that the ribbon has sufficient surface area for the overall resistance of the contact strip, i.e. the equivalent resistance between the two series of contacts 3A and 3B of all the blades, to remain within acceptable values in terms of heating of the blades by the currents that will flow.

[0028] If the overall resistance of the contact strip must be reduced without increasing the surface of the ribbon or reducing its thickness, it may be necessary for the metal-plating to be effected on a ribbon that has already been punched, i.e. after the blades have been cut out and possibly twisted and bent. This is because the metal that is a good conductor then covers both surfaces and the edges of each blade. Consequently, in a contact strip obtained by this method, the current that flows between the two contacts 3A and 3B of a blade is divided between the thickness of the ribbon 9 and the edges of the blade, so that the overall resistance of the contact strip obtained can be reduced to some degree. However, metal-plating at this stage usually entails a significant cost increase compared to an order of operations in which the metal-plating is effected right at the beginning of the process, for the reasons previously stated.

[0029] The first portion of figure 3 is a view of secondary and primary contact strips in longitudinal section in a plane perpendicular to the plane P of the ribbon and passing through its longitudinal axis A. The primary contact strip, obtained after the operation of twisting the blades of the contact strip shown in figure 2, can be seen on the right-hand side in figure 3. The blades 3 are spaced by the same original pitch d_1 as the openings 2. In this representation, the tongues 4 are already inclined relative to the plane P of the ribbon, as can

be seen in figure 5. The left-hand side of the figure shows the secondary strip obtained after pleating the two continuous edge strips ES_1 and ES_2 of the ribbon, so that the blades 3 are spaced by a new pitch d_2, and before its heat treatment. It must be remembered that in a fabrication method according to the invention the pleating operation mentioned above must take place after metal-plating the ribbon, to avoid poor plating in the mutually overlapping portions of the blades.

[0030] To give an idea of the orders of magnitude involved, the original pitch d_1 is 2.5 mm, for example, and the corresponding new pitch d_2 is 1.7 mm, yielding a blade approach factor d_1/d_2 close to 1.5. It may be noted that the blades partly overlap each other in the direction perpendicular to the plane P of the ribbon. However, the distance between the edge of one blade and the surface of the nearest adjacent blade must remain sufficient for that edge not to come into contact with said surface when the resulting contact strip is installed and compressed between two parts of a connector, such as the two parts 11 and 12 shown in figure 5. Accordingly, starting with a given primary contact strip, there is a lower limit for the new pitch d_2 and this limit must not be exceeded. The limit depends in particular on the inclination of the blades to the plane of the ribbon, the required elasticity of the blades, and the width D and the thickness of the blades. It is therefore necessary to arrive at a compromise to obtain a pitch d_2 that is as small as possible, in order to obtain a high blade density combined with a good conduction capacity for high currents.

[0031] The original pitch d_1 must be sufficient to be able to cut the blades fairly wide so as to be able to bend them and form areas with satisfactory contact surface areas with the two parts of the connector for which it is intended. Moreover, it is important to have blades whose width D is sufficient to achieve the required elastic movement in the area of the

contacts of each blade, since each blade of the contact strip obtained is able to pivot elastically. However, a wide blade would to some extent make it necessary to increase the new pitch d_2, which goes against achieving a high density of blades. As it is not desirable for the original pitch d_1 to be greater than 1.25 times the required width D of the blades, as explained in the commentary relating to figure 2, it is therefore necessary to arrive at a compromise to minimize the original pitch.

[0032] There is an optimum range of values for the approach factor d_1/d_2, which corresponds to a new pitch d_2 that is sufficiently small to obtain a relatively high blade density from a primary contact strip whose original pitch d_1 is sufficiently large to form blades that are electrically and mechanically satisfactory. A blade approach factor from 1.3 to 2 constitutes an optimum compromise and fully satisfies the technical imperatives referred to above.

[0033] The second portion of figure 3, situated under the first portion, is a plan view of the primary and secondary contact strips shown in the first portion of the figure. The mutual overlapping of the blades of the secondary strip is clearly visible on the left-hand side of the figure. After the pleating operation, the tongues 4 are regularly spaced at the same new pitch d_2 as the blades.

[0034] As can be seen in the first portion of figure 3, the pleats 5 formed transversely in the ribbon to move the blades 3 closer together all protrude on the same side of the plane P of the ribbon, preferably the same side as that toward which the tongues 4 are bent. In this way the two continuous edge strips ES_1 and ES_2 of the ribbon assume a crenelated shape with pairs of crenelations separated by the bottom of a pleat 5.

[0035] The internal walls of a pleat 5 do not touch each other, and so there is no risk of the bending applied to the continuous edge strips of the ribbon during pleating breaking the strips. This is most advantageous in the situation in the which the edge strips ES_1 and ES_2 are covered with a conductive layer 15 like the central strip CS of the ribbon, since it is mainly in the layer 15 that there may be a risk of tearing if the pleats are formed by pressing one wall against another.

[0036] Each pleat therefore has an interior space forming a cavity 6 that is open in the plane P of the ribbon. Each cavity has two substantially plane walls that are parallel to each other and perpendicular to the plane of the ribbon in the figure 3 embodiment, and also includes a semicylindrical wall that forms the bottom of the cavity 6. The bottom of this cavity therefore has a curvature diameter δ that corresponds to the diameter of the half-cylinder, and in this embodiment the diameter δ is also equal to the distance between the two plane walls of the cavity.

[0037] Alternatively, it is possible to make pleats 5 with two plane walls that are not parallel to each other, for example of the shape shown in figure 3a. In this figure, one of the two plane walls of the pleat 5 is perpendicular to the plane of the ribbon, but this is not essential and an angle other than 90° could equally well be used. The wall that forms the bottom of the cavity 6 partly espouses the shape of a cylinder of diameter δ, and therefore has a curvature diameter equal to δ.

[0038] Each transverse pleat 5 advantageously has a height h such that the ratio d_2/h between the new regular pitch d_2 and its height is from 1.7 to 2.5. The height of a pleat is the distance between the plane surface of the edge strip at the end of the pleat and a plane parallel to that surface which is tangential to the summit of the pleat, assuming that each

pleat protrudes from the same side of the plane of the ribbon. For example, the pleat height can be 0.85 mm for a new pitch of 1.75 mm, which yields a ratio d_2/h of approximately 2. The range specified above constitutes a good compromise such that the tongues 4 are sufficiently wide but the pleats 5 are sufficiently high to move the blades 3 closer together with the required new pitch d_2. The width of a tongue is measured at the level of the longitudinal bend that it forms with a continuous edge strip ES_1, ES_2 of the ribbon.

[0039] The tongues 4 must have some stiffness, combined with some elasticity, first of all so that they can be engaged in grooves in a first part 11 of a connector like that shown in figure 5 when fitting the contact strip. The ends of the tongues must then bear sufficiently against the inclined walls of the grooves 13 to hold the contact strip in bearing engagement against the part 11. If the tongues were too narrow the contact strip would be held against the part 11 insufficiently firmly, and there would be a risk of the strip becoming disengaged when the two parts 11 and 12 of the connector are disconnected.

[0040] For each transverse pleat 5 satisfying the previously specified range of values for the ratio d_2/h, the ratio h/δ between the height h of the pleat and the curvature diameter δ of the bottom of the cavity 6 of the pleat is preferably and advantageously from 2.4 to 3.2. If the edge strips ES_1 and ES_2 of the ribbon are covered with a conductive layer 15, a ratio h/δ in the range specified above in particular allows sufficiently wide bends for there to be no risk of the edge strips breaking during pleating. For example, for a pleat height of 0.85 mm, the curvature diameter δ can be 0.3 mm, yielding a ratio h/δ of approximately 2.8.

[0041] Figure 4 is a diagram showing a blade shape slightly different from a more conventional blade shape like that of the contact strip shown in figure 2. The blade 3 has a middle portion 7 that is narrower along the longitudinal axis A of symmetry of the ribbon, as

in some prior art embodiments, such as in the patent document CH590570. This blade shape is appropriate for the middle portion of the blade not to be able to come into contact with a connector part, such as the part 11 or 12 that can be seen in figure 5, after the blade is twisted about its axis A_T and its lateral edges are bent to form the contacts. Thus each of the two faces of the blade has two contact areas Z_1 and Z_2 on respective opposite sides of said middle portion and symmetrical with respect to the axis A. .

[0042] In figure 5, a contact strip formed from a ribbon of blades like that shown in figure 4 has been installed in a first part 11 of a connector. The contact strip is shown diagrammatically in cross section through a blade in a plane perpendicular to the plane of the ribbon. The first part 11 includes two longitudinal grooves 13 for immobilizing the tongues 4 of the contact strip when the latter has been installed. Also, each groove 13 is sufficiently deep for the pleats 5 of the two continuous edge strips ES_1 and ES_2 of the ribbon not to abut against the bottom of the groove when the contact strip is compressed between the two connector parts 11 and 12. The first part 11 of the connector has between its two longitudinal grooves 13 a plane or cylindrical longitudinal surface 20 against which the contact 3B of the bottom face of the blade is pressed and held when the tongues 4 are installed in the grooves. The two end portions 21 and 22 that delimit the longitudinal surface 20 laterally relative to the two longitudinal grooves 13 can constitute edge displacement abutments for the contact strip. In the event of a friction force in the direction transverse to the contact strip, in particular when connecting or disconnecting the two connector parts 11 and 12, the contact strip tends to move laterally. If the tongues 4 are not sufficiently rigid to limit this movement, the pleats 5 of a continuous edge strip ES_1 or ES_2 can abut against an end portion 21 or 22 and prevent any further movement.

[0043] The contact 3A of the top face of the blade is adapted to bear against a second part 12 of the connector as soon as the two parts 11 and 12 are interconnected. The second part 12 is shown in dashed outline in its connection position. It is clear that each contact 3A or 3B consists of two contact areas, such as the areas Z_1 and Z_2 for the contact 3A. The surface area of contact between a blade face and a connector part is therefore substantially increased relative to a more conventional embodiment in which each face of a blade has only one contact area. Thus the contact resistance between a contact 3A or 3B and a respective connector part 12 or 11 can be significantly reduced.

[0044] Figure 6 shows diagrammatically in cross section part of a contact strip analogous to that shown in figure 5. The connector part that retains the strip includes means for longitudinally immobilizing the strip, which can be advantageous in some relatively marginal embodiments. The means referred to consist of crenelations 14 that correspond to shallower areas of the longitudinal groove 13, the bottom of a crenelation 14 being formed in this case by the bottom of the groove 13. Once the strip has been fitted, the bosses of the crenelations are closer to the plane P of the ribbon than are the bosses of the pleats 5. Thus if the tongues of the contact strip slide in their retaining grooves 13 if a high force is applied to the contact strip in the longitudinal direction, the pleats 5 abut against the crenelations 14 and prevent further longitudinal movement of the strip. For this kind of embodiment, it is not necessary to have as many crenelations 14 in the grooves 13 as there are pleats 5 in the associated contact strip, as a small number of crenelations distributed over the length of the strip may suffice.

[0045] Figure 6a is a diagrammatic view of the device from figure 6 in longitudinal section in the plane P'. As in the device from figure 5, the bottom of the groove 13 is sufficiently far

away from the pleats 5 not to touch them when the contact strip is compressed. It is clear that the pleats 5 can abut on the sides of the crenelations 14 in the event of longitudinal displacement of the strip.

[0046] Accordingly, with an embodiment as shown in figures 6 and 6a for the first connector part 11 that supports the contact strip, the strip can be nested in this connector part and securely immobilized in the longitudinal direction. This naturally implies immobilizing the strip against rotation if the connector is cylindrical.